In the matter of

State of Oklaholma, ex rel., A. Drew Edmondson in his capacity as Attorney General of the State of Oklahoma, and Oklahoma Secretary of the Environment, C. MILES TOLBERT, in his capacity as the Trustee for Natural Resources for the State of Oklahoma, Plaintiffs

v.

Tyson Foods, Tyson Poultry, Tyson Chicken, Inc., Cobb-Vantress, Inc., Aviagen, Inc., Cal-Maine Farms, Inc., Cargill, Inc., Cargill Turkey Products, LLC, Georges, Inc., George's Farms, Inc., Peterson Farms, Inc., Simmons Foods, Inc., and Willowbrook Foods, Inc.
Defendants.

CASE NO. 05-CV-329-GFK-SAJ

in the United Station District Court
for the Northern District of Oklahoma

Expert Report

of

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For long-term poultry manure applications, the organic phosphorus may be converted to inorganic forms such as calcium phosphates. (Lehmann, et al., 2005)

A study by Lehmann et al. (2005) suggests that calcium phosphate dynamics are a likely control mechanism of the portion of available and mobile phosphorus found in soils amended with large amounts of manure. For low phosphorus soils (below 159 mg/kg), aluminum and iron phosphates were also found to influence the mobility of phosphorus by McDowell and Sharpley (2003). (Lehmann, et al., 2005; McDowell & Sharpley, 2003)

6.4.3.5 Hazardous Substances in Poultry Waste

Assuming the list of Hazardous Substances and Reportable Quantities (table 302.4, 40 CFR § 302.4) includes not only the specific chemical listed but also chemical compounds, chemical forms and chemical combinations of the listed chemical, analyses of poultry waste and literature reports include many hazardous substances including:

- Ammonia (CASRN 7664417)
- Ammonia and Compounds
- Arsenic and compounds
- Cadmium and compounds
- Chromium and compounds
- Copper and compounds
- Lead and compounds
- Manganese compounds
- Nickel and compounds
- Nitric Acid (CASRN 7786-81-4)
- Nitrogen oxides
- Nitrosamines
- Phosphorus and compounds
- Phosphoric acid (CASRN 7664382)
- Polynuclear aromatic hydrocarbons
- Radionuclides
- Selenium and compounds
- Sodium and compounds
- Sulfuric acid (CASRN 7664939)
- Thiourea (CASRN 62566)
- Unlisted hazardous waste with characteristic of reactivity
- Zinc and compounds

The CAS Registry Number 7723140 refers to elemental phosphorus. This substance does not naturally exist in the environment. However phosphorus is present as compounds in the feed, poultry waste and poultry waste in soils mainly as phosphate (PO_4^{-3}) compounds. As an environmental constitutent dissolved in moisture or water (the mobile phase), the exact chemical composition of the phosphate will depend upon the pH of the water. At a neutral pH, the phosphate will exist as dissolved aqueous anions both: $H_2PO_4^-$ and HPO_4^{2-}. At the same pH value, these chemical

forms and proportions of these chemical forms are identical to the chemical forms and proportions of the listed substance phosphoric acid.

6.5 Pathway Sampling Approach

The overall sampling approach was to collect and analyze water or solid materials (wastes, soils and sediments) in each major compartment (component) of the environment. The purpose of this approach was to document, if possible, the fate and transport of poultry associated contamination from its origin (land disposal of poultry waste) through each environmental transport step to the ultimate deposition in the sediments and water of Lake Tenkiller. **Figure 6.5-1** illustrates each of the major environmental components. These include (in order from source to final location)

- Poultry waste from the poultry houses, upper right hand corner of **Figure 6.5-1** (samples collected from the poultry houses in the IRW were called litter or facility, FAC, samples)
- Soils from fields on which land application of the poultry waste occurred (samples are called land application locations, LAL, samples)
- Water runoff from fields with waste as a result of precipitation (rainfall) events (samples are called edge of field, EOF, samples)
- Waters from small tributarties in watersheds in which poultry houses exist and waste disposal occurred (samples are called high flow station, HFS, samples)
- Ground water in shallow alluvial materials near streams that may be contaminated as a result of infiltration (rainfall moving through the soil) on waste applied fields (samples were collected using Geoprobe techniques and are called GP samples)
- Ground water from deeper geologic strata (samples were collected from existing homeowner wells and samples are called ground water, GW, samples)
- Water from springs that may represent contaminated groundwater resulting from infiltration on fields (samples are called spring, SPR, samples)
- Water from rivers within the IRW including both small and larger rivers (samples from larger streams at USGS stations are called USGS samples; samples from other locations, both large and smaller streams, are called river stations, RS, or biological stations on the rivers, RBS)
- Waters collected from streams during base flow conditions that represent groundwater recharge (samples from the small tributarties are call HFS-BF; however, all river samples have a designation indicating whether samples were collected during high flow or base flow)
- Waters from Lake Tenkiller (samples from Lake Tenkiller are designated lake, LK, samples)